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CAN THE MILITARY BENEFIT FROM CORPORATE USE OF STRATEGIC INFORMATION SYSTEM PLANNING?

by

Stanley A. Mullen

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Thesis Advisor:	Kishore Sengupta
Associate Advisor:	John Osmundson

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The Naval Construction Force, much like the Department of Defense, is adrift without a formal strategic plan for building an integrated information system. The purpose of this study is to explore and discuss how Strategic Information System Planning (SISP), is used by corporate business to plan integrated information systems The paper examines how SISP is used as means of gaining competitive advantages by corporate business in the marketplace with a view of how it can benefit the military. In addition, this paper will examine business process improvement as a means of making processes more efficient prior to the development of an information system. This research targets the development of information systems by the Naval Construction Force. An ancillary objective of this thesis is to provide the Naval Construction Force with a framework for developing integrated information systems. Throughout this research, the SISP methodology of Information Engineering will be used to make comparisons to corporate business that use this strategy and applications within the Naval Construction Force. This methodology will also be used to determine if this strategy can be tailored to suite the needs of the Naval Construction Force in information system planning.

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Stanley A. Mullen
Lieutenant Commander, United States Navy
B.S., Savannah State University, 1987

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Author: Stanley A. Mullen

Approved by: Kishore Sengupta, Thesis Advisor

John Osmundson, Associate Advisor

Dan Boger, Chairman
Information Systems Academic
Group

ABSTRACT

The Naval Construction Force, much like the Department of Defense, is adrift without a formal strategic plan for building an integrated information system. The purpose of this study is to explore and discuss how Strategic Information System Planning (SISP) is used by corporate business to plan integrated information systems. The paper examines how SISP is used as a means of gaining competitive advantages by corporate business in the marketplace with a view of how it can benefit the military. In addition, this paper will examine business process improvement as a means of making processes more efficient prior to the development of an information system. This research targets the development of information systems by the Naval Construction Force. An ancillary objective of this thesis is to provide the Naval Construction Force with a framework for developing integrated information systems. Throughout this research, the SISP methodology of Information Engineering will be used to make comparisons to corporate business that use this strategy and applications within the Naval Construction Force. This methodology will also be used to determine if this strategy can be tailored to suite the needs of the Naval Construction Force in information system planning.

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I. INTRODUCTION

James Martin and Joe Leben, noted authors on Information Engineering, give a good analogy of building an information system in their book entitled, Strategic Information Planning Methodologies (1989):

> It would be unthinkable to build a battleship without an overall plan. Once an overall plan exists, separate teams can go to work on specifying the details for individual components. The design of databases and corporate information systems that access them is often as complex as building a battleship, yet, in most enterprises, it is done without an overall plan of sufficient detail to make the components fit together. (p. 3)

"Planning" is defined in Webster's II Dictionary (1984) as, "A detailed scheme, program, or method worked out beforehand for the accomplishment of an objective." Eisenhower once stated, "Planning is everything, the plan is nothing." When you have a method for planning, even though the situation may change, the plan can be adjusted accordingly.

In today's explosive world of information technology, it is important to have a detailed program explaining how to incorporate new developments in technology into the overall strategy of the organization. Without a plan, an organization gets into a downward spiral of trying to keep pace with technology while not matching the information needs with resources of the organization.

Information system planning has become a significant business activity. Strategically planning an information system is becoming increasingly important

as information technology is becoming entrenched in the day-to-day operations of an organization.

A. PURPOSE

The purpose of this study is to explore and discuss how Strategic Information System Planning (SISP) is used by corporate business to plan integrated information systems. This paper examines how SISP is used as means of gaining competitive advantages by corporate business in the marketplace with a view of how it can benefit the military. In addition, this paper will examine business process improvement as a means of making processes more efficient prior to developing an information system.

The primary research objective is: Can the military benefit from SISP used by corporate business to integrate their information systems? Subsidiary objectives include: Why is there a need to strategically plan an information system? What are the steps involved in strategically planning an information system? Can SISP make effective use of data resources? And, what are the prerequisites of SISP?

This research targets the development of information systems by the Naval Construction Force. An ancillary purpose of this thesis is to provide the Naval Construction Force with a framework for developing integrated information systems. Throughout this research, the SISP methodology of Information Engineering will be used to make comparisons between corporate business that use this strategy and applications within the Naval Construction Force. This methodology will also be used to determine if

this strategy can be tailored to suite the needs of the Naval Construction Force in information system planning.

B. BACKGROUND

The Naval Construction Force consists of commissioned Civil Engineering Corps Units of the U.S. Navy, also called Seabees, who operate under the control of the Chief of Naval Operations within the Department of Defense (DOD). Seabees provide numerous general-engineering capabilities in support of the U.S. Navy and Marine Corps. Seabee is derived from the first construction units, or Construction Battalions (CB), that were formed during World War II. (NAVEDTRA, 1988)

The Seabees simple motto tells the story: "We build, we fight." From the island hopping of World War II and the cold of Korea, to the jungles of Vietnam and the mountains of Bosnia, the Seabees have built entire bases, have bulldozed and paved thousands of miles of roadway and airstrips, and have accomplished a myriad of construction projects. (Seabee History, 1999) The Seabees are well-known for their manual dexterity in constructing facilities in support of amphibious assaults. However, in the past, their vocation within the naval service has not been as heavily computer-intensive as those of other commissioned operating units. The Seabees realize the need to apply modern information technology to better control and coordinate their efforts. Nevertheless, they are just beginning to harness the potential of these information systems to support their mission. The Seabees can easily define obvious information

requirements, but they need a comprehensive, well-structured development methodology to create an integrated information system.

Why is there a need for DOD organizations, like the Naval Construction Force, to strategically plan an information system? DOD organizations do not compete in the same competitive marketplaces as corporate America. However, DOD organizations, like the Naval Construction Force, do compete for scarce government resources in today's world of reduced government spending. Congress wants to see a return on investment of approved government budget items. The following excerpt supports the importance of strategically planning information systems.

Jack Robertson writes in *Computer, Trade, & Industry* (May 23, 1992),

> Where are all the Pentagon's billion-dollar computer savings that the new Corporate Information Management revamping was supposed to bring?
>
> Three years into the stem-to-stern computer restructuring, the Defense Department computer costs have gone up another billion to an estimated $9 billion per year level...
>
> A major obstacle: many DOD computer operations have grown patchwork-fashion over the years until their custodians have only vague understandings of how the total system works. (p. 9)

Return on investment is the "yardstick" used to measure spending of defense dollars in terms of productivity related to how well defense information systems deliver improvements in mission readiness. In these austere times, money is no longer available to invest in migrating aging systems or in developing inefficient systems that continually require replacing to meet the goals of the military. In 1995, the House Armed Service

Committee slashed $680 million from the DOD budget ear-marked for new information technology systems, saying the Pentagon has shown "no demonstrated return" on $54 billion in information technology investments over the past five years. (Federal Computer Week, 1994)

A vast amount of DOD resources have been dedicated to designing, implementing, and maintaining information systems. To have a competitive market for the DOD and its subordinate-level organizations means justifying future appropriations based on a well-defined, strategic plan that ensures a return on investment.

The Naval Construction Force, much like the DOD, is adrift without a formal plan for building an integrated information system. The problem exists with the Naval Construction Force not taking a total-system approach to determining their information needs. Their attempts at developing an integrated information system can be best described as "small islands of information mechanization." (Blumenthal, 1969) These small islands of information mechanization concentrate more on sub-systems of information than on how these sub-systems can be integrate into the enterprise-level architecture of the organization.

An example of the Naval Construction Force's small island of information mechanization is the current development of Apex, a web-based query system designed by the Space Warfare System Center in Chesapeake, Virginia. Apex is designed to provide field-level asset visibility by extracting data from MicroSnap--the Naval Construction Force's maintenance, supply, and financial logistic database. After data is

extracted by Apex, it is used in an Excel spreadsheet program to report readiness up the chain of command.

The data structure of MicroSnap does not accurately reflect the Table of Allowances of the Naval Construction Force's. Tables of Allowances are the primary authorized allowance database of the Naval Construction Force. It is a listing of the personnel, equipment, material, and facility allowances approved by Chief of Naval Operations for the performance of the unit's mission(s) in contingency, wartime, and disaster recovery operations. (COMSECOND/THIRD INST 4400.3, Appendix 11) These Tables of Allowances determine the very essence of Naval Construction Force readiness. However, only limited thought was given to structuring the data (i.e., format and input) accurately or ways to mine (i.e., converting and transferring) the data directly into readiness information.

In the past, 16 different databases for Table of Allowances evolved from antiquated legacy systems. Data contained in these Tables of Allowances are often incomplete, non-uniform, and obsolete. Transaction processes used to update these tables follow broken data paths. Data is gathered from various remote sites via different automated management information systems and from hardcopy records from manual inventory processes. In addition, more reports were required from units to validate their readiness based on these Tables of Allowances. (Thate, 1999) MicroSnap is an attempt to fuse this data into one working database.

C. SCOPE AND METHODOLOGY

The scope of this study will focus on the use of Information Engineering as a structured methodology of SISP. The primary concentration of this study will be to parallel Information Engineering in corporate business to a framework for use by the Naval Construction Force in strategically planning an information system. Other areas of the study will include assessing SISP through an example at Federal Express and discussions of business process improvement through corporate use to include: Total Quality Management, Business Process Reengineering, and Best Management Practices. The research methodology consists of the following:

1. Conducting a literature search of naval instructions, programs, books, and electronic and library information resources.
2. Exploring and discussing different types of structured SISP.
3. Analyzing a case study on SISP with emphasis on a framework for the Naval Construction Force.
4. Conducting a thorough overview of the Naval Construction Force's mission, management requirements, and data resources.
5. Exploring and discussing business process improvement.
6. Generating recommendations and conclusions that will aid in constructing a framework for the Naval Construction Force's SISP.

D. ORGANIZATION OF STUDY

The following chapters in this research document the necessity for the Naval Construction Force to devise a well-defined framework for strategically planning an information system. Chapter II examines Information Engineering and various SISP methodologies used in corporate business enterprises. Chapter III provides a case analysis of Information Engineering with emphasis on a framework for the Naval Construction Force. Chapter IV discusses business process improvement and various approaches used to make processes more efficient. Chapter V provides recommendations of a framework for the Naval Construction Force to use in developing information systems. Finally, Chapter VI discusses my recommendations and conclusions.

II. STRATEGIC INFORMATION SYSTEM PLANNING METHODOLOGIES

A. OVERVIEW

We have rapidly moved from the "Computer Age" to the "Information Age." Since the invention of the punch card by Herman Hollerith and James Powers to the development of the microprocessor, computers have redefined the way mankind processes data into useful information. Computing power has increased from processing hundreds of lines of code an hour to millions of lines of code a second. A typical microprocessor contains semiconductor chips that can execute tens of thousand of calculations in the blink of an eye, all in the space of a fingernail.

Information and control are essential components of an organization. The initial focus of using computers in business was to automate manual transactions. Computers were then used to correlate data from these automated transactions into reports for the end user to decipher what was important. Now, computers and their related systems are used to provide a broad range of information, including artificial intelligence, decision support, financial forecasting, and inventory control.

Developments in the communication industry, coupled with those in the computer industry, have formed the basis for information technology as a studied discipline within academics and business. Information technology can be viewed as the application of modern technology in computers and communications.

The importance of information technology in business has increased significantly since its inception in the mid-1950s. Businesses are becoming increasingly dependent on emerging information technological developments for their survival and growth. Information technology is generating more data, as a company performs its activities, permitting the capture of information that was not available before.

John F. Rockart, Director, Center for Information System Research at Massachusetts Institute of Technology (MIT) Sloan School of Management states, (Rockart, 1996)

> In the1990s, information technology has become the fourth major resource available to executives to shape and operate an organization. Companies have managed the other three major resources for years: people, money, and machines. But today, information technology accounts for more than 50 percent of the capital goods dollars spent in the United States. (p. 43)

This trend of capital spending on information technology will only increase. Businesses are realizing the need to continue investing in this technology to stay ahead of the competition.

Given the increasing importance of emerging information technological developments to corporate well-being, a systematic process of identifying, evaluating, and acquiring information systems are fundamental to successful business operations. This systematic process must balance the information needs of the business with information technological resources and organizational goals to provide a competitive advantage.

The focus of attention on information systems is currently one of a strategic view: How to best align the information system with that of the organization's goals. Strategic

Information System Planning (SISP) is the process of creating a long-range plan of computer-based applications to enable an organization to achieve information technology goals. (Lederer, Sethi, 1992)

But, what is an information system? An information system can be composed of interdependent systems and sub-systems. They, with the use of automated data processing systems, attempt to provide timely and accurate management information, which permit optimum management decisions. (Dickey, Arya, 1970)

From the 1950s to the early 1960s, the systems concept was non-existent in large business organizations. Large businesses were centralized organizations with major departments formed along functional lines within the corporation. These departments often did not interact with other departments. Sales function was performed mainly without regard to the manufacturing function, and production control was not adequately coordinated with financial or personnel planning. (Eldin, Croft, 1974)

As the need for an information systems department developed, it, too, did not functionally interact with other departments. The information systems department functions were only to provide management with the required data processing and automated transaction reports. Eldin and Croft go on to say,

> Some of these functions were included payroll, accounts receivable, and accounts payable, personnel records, and so on. These information systems were developed as separate entities with each performing its specific function. In addition, each of these information systems was developed for one specific user, such as the accounting department, payroll department, or personnel department. Therefore, there was much duplication of effort and data in each of the information systems. In summary, these early information systems were developed for a specific application and for a specific user, generally for lower management to assist it in its day-to-day operations. (p. 38)

This approach was redundant and expensive, and it did not provide needed information for overall control of the organization.

As a result of businesses becoming more complex and improvements in information technology, there was a need for a different approach to business management. A fairly stable approach to information technology developed between 1965 and 1975. It was during this era that information technology, in most media and large organizations, was characterized by efforts to integrate their core business functions with information technology. This emergence of the information system department resulted in increased influence within the decision-making level of the organization. (Boynton, Zmud, 1987)

Businesses realized the critical requirement for information system planning as they invested more and more capital in information systems. Spending on information systems went from three percent of the U.S. Gross National Product in 1990 to five percent in 1995. It has accounted for more than a third of the growth of the entire American economy over the past four years. (Vinik, 1995) Information system development has become an industry within itself in the United States. Over the last

decade, spending on information systems has been estimated at three trillion dollars. (Davenport, 1997)

There is extensive literature and research devoted to information system planning. Various structured methodologies have been developed to address the issue of aligning a business information system with the overall goals of the organization. Some of the more popular methodologies include: Critical Success Factors (Rockart, 1979), Business Systems Planning (IBM, 1981), Portfolio Management (McFarlan, 1981), Value Chain (Porter, 1985), Nolan Norton (Moskowitz, 1986), Entity-Relationships, and Information Engineering (Martin, 1989). They are described briefly as a background of approaches in SISP that led to the development of Information Engineering.

Critical Success Factors was one of the first more popular approaches in SISP. John Rockart is well-known for his work during the late 1970s with the Massachusetts Institute of Technology (MIT) Research Teams on Critical Success Factors. This system approach was based on earlier management literature by D. Ronald Daniel. Daniel was curious why vast amounts of information produced by large organizations were of such little use to the same firms that produced it. He is quoted (Daniel, 1961),

> A company's information system must be discriminating and selective. It should focus on 'success factors.' In most industries there are very limited factors that determine success; these key jobs must be done exceedingly well for a company to be successful. (p.111)

These critical success factors are the key areas where things must go right for the business to succeed.

The concept has been used for at least three related purposes. First, critical success factors can clarify management focus by highlighting similarities and differences among executives. Second, critical success factors can be used to develop decision support information based on management information needs. Third, critical success factors can expose the gap between available and required information as it relates to the importance of needed information by management.

Critical success factor procedures begin with an interview of top executives to determine what it takes to be successful in business. After a few interviews, the results are analyzed for six or seven of the most critical factors. These factors must be measurable and quantifiable to build the required system. Based on these factors, an automated reporting system is created to improve these functional areas.

One strength of critical success factors includes putting most of the planner's energies into finding what is important and supporting it with an information system. Because this methodology emphasizes measurement and reporting on critical factors, it focuses on the quantitative aspects of the factors it identifies. However, certain factors are not amiable to quantitative description or analysis, such as how useful the information is to a particular situation. One person may think it is intuitively obvious and is not important as a success factor. (Moskowitz, 1986)

Another methodology is International Business Machine's (IBM) Business Systems Planning, which was developed in 1975. A business must determine how its mission, objectives, and functions are used in processes within the firm. These processes are analyzed for data needs and classes. Similar data classes are combined to form a

general data classification scheme and database. The overall business system plan incorporates these databases along with an overall system architecture and implementation schedule of individual sub-systems. Heavy emphasis is placed on top-management commitment and involvement.

Business System Planning has significant strengths, including its emphasis on data as an organizational resource. However, the process is extremely costly and cumbersome to perform perhaps reflecting its almost three-decade-old origin. The studies required are lengthy and can overlook circumstances that can benefit from this approach. It can also overlook situations that do not lend itself to this approach, such as top management being unaware of certain business processes.

The next methodology is Portfolio Management, which is less formal than the other methodologies. It divides the organization by business potential and assesses the risk of developing supporting information sub-systems for these business areas. These information sub-systems must enhance the business productivity and keep costs low. A monetary value is clearly placed on sub-systems.

Consideration is also given as to where the information system activities lie with the following four-stage model. Stage 1: Initiation in which technology specification, systems creation, and original investments are crucial. Stage 2: Expansion in which learning and adaptation are paramount. Stage 3: Control in which rationalization and elaboration are important. Stage 4: Maturity in which continuance and integration are most significant.

In the early stages, risks are greater because more uncertainties exist. As the business matures, it can focus more clearly on the information support it needs. More sub-systems are developed in the later stages. The business understands its information needs better and there is less risk. Information sub-systems that are most likely to succeed in the applicable stages are the ones that are then developed into the overall information system.

Subsequently, Michael E. Porter, professor of business administration at Harvard Business School and noted author of Competitive Strategy (1980), is credited with the development of the “Value Chain” as an SISP. In his book, Mr. Porter explains that an important concept that highlights the role of information technology in competition is the Value Chain. Just as strategists have studied the value-added chain to discover promising business opportunitites, clever information analysts are studying it to reveal opportunities for improvement through information.

This concept divides a company’s activities into technologically and economically distinct value activities it performs to do business. Porter’s narrow approach is to develop information systems centered on processes that add value to services or products. To gain competitive advantages over its rivals, a company must either perform these activities more cost-effectively or more time-efficiently than its competition. Information systems design on this premise focuses on the steps required to capture, manipulate, and channel data necessary to perform these value activities.

Following Porter’s Value Chain, Richard Nolan and David Norton developed a permutation of IBM’s Business System Planning. Their namesake methodology has the

additional benefit of looking at several different levels of controls very explicitly. The Nolan Norton Methodology divides the organization into strategic, operational, and tactical control phases. Strategic-level support assesses where the business currently is and where it wants to be in the future. Operational-level support is the day-to-day support of running the business. Finally, tactical-level support is when the business is competing against other organizations to stay in business.

The methodology further subdivides each of these phases into separate functions or processes. The general proposition is that systems in different stages need different support. For example, early-life-cycle stages need strategic information support. Mid-life-cycle systems need operational information support. Finally, later-life-cycle systems need tactical information support. This approach is very detailed at each phase. However, it is very cumbersome and needs an expert to help run the Nolan Norton strategic planning process. (Moskowitz, 1986)

In the sequence of methodology development came Entity-Relationship Analysis, which is a theoretical approach to building a structure on top of the data architecture or existing information system. Entity-Relationship analyzes entities in relations to one another and maps these relationships using formal rules and diagrams to develop a cohesive picture of organizational information flows. This model is a representation of the structure and relationships of what needs to be in the database to support the user's requirements. It also allows the planner to give each department its subset of the model for input on how it should fit or interface with other subsets.

Most recently, James Martin has become the modern day expert on Information System Planning. His comprehensive approach to SISP can be viewed as a standard to ensure successful information system planning. James Martin's development of Information Engineering, as a structured methodology, is a more complete approach to developing an information system and is the focus of this research. The underlying theory and procedures will be further discussed in the next section.

The aforementioned methodologies were not necessarily created independently of each other. In most cases, the developments of these methodologies were basically improvements of their predecessors. Tables 2.1 and 2.2 compare the principal points of each methodology.

Methodology	Approach	Strengths	Weaknesses
Critical Success Factors	Top-Down Planning	Focuses on critical needs. Broad in scope.	Possible ambiguities. Must quantify success factors.
IBM's (Business System Planning)	Top-Down Planning	Defines classes of data. Identifies relationships, gaps and redundancies.	Costly Cumbersome
Portfolio Management	Risk Assessment	Helps organization understand value of information. Develops systems most likely to succeed.	Not a very formal methodology. Looks at business potential.
Porter's Value	Value added to process	Develops information system based on processes that are of value.	Narrow focus.
Nolan Norton	Function/Application Analysis	Divides organization into functional areas. Looks at different level of the organization.	Narrow focus. Cumbersome. Need an expert to run the process.
Entity-Relationship	Data Architecture, Information Modeling	Detail data mapping. Allows subset modeling.	Strategic Plan is determined after database creation.
Information Engineering	Top-Down Planning, Bottom-Up design	Comprehensive Knowledge based	Very time consuming.

Table 2.1 Comparison of Methodologies

	Phases			
Methodology	**Planning**	**Analysis**	**Design**	**Implementation**
Critical Success Factors	●	◉	○	○
IBM's (Business System Planning)	◉	●	◉	○
Portfolio Management	◉	◉	○	○
Porter's Value Chain	●	◉	○	○
Nolan Norton	●	◉	◉	○
Entity – Relationship	○	●	●	◉
Information Engineering	●	●	●	●

Legend: ● – Heavily covers

◉ – Moderately covers

○ – Does not cover

Table 2.2 Usage of Methodology

B. INFORMATION ENGINEERING

A basic premise of information engineering is that once data relationships in an enterprise are established they do not vary dramatically over time. The value of the data might change, but the structure of the data does not, if it is well-designed to begin with. A major advantage of this approach is that an organization's information needs are less likely to change (or will change slower) than its business process. For example, unless an organization fundamentally changes its business, its underlying data structure may remain reasonably stable for more than ten years. (Hoffer, George, Valacich. 1996)

The term "Information Engineering" refers to the set of interrelated disciplines that are needed to build a computerized enterprise based on information systems. (Martin, 1990) Information engineering is a generic class of methodology that can vary in different organizations based on their information needs. High-level plans and models are represented by a set of computer automated tools, which allow separately developed sub-systems to fit into a framework of the entire system. Information engineering builds an encyclopedia of knowledge about the organization. Data, processes, and design of sub-systems are incorporated in this knowledge-based encyclopedia, which plans and models the overall system. A data dictionary is used in conjunction with the encyclopedia to keep track of the names and descriptions of entities, processes, and variables employed in the model.

The computer-automated software tools used by systems analysts to develop information systems are recognized as Computer-Aided Software Engineering (CASE)

tools. Manufacturers, such as CASEWISE Systems Ltd., Corporate Dynamics Ltd., Logicworks, Success Software Inc., and a host of others, all provide toolkits for this use. CASE helps provide an engineering-type discipline to systems design. Diagrams generated by CASE tools represent planning information, system overview, data flow, data models, and program structures. The complexities of large information systems are managed better by this method, instead of by pencil and paper models used in the past. Further discussion of CASE tools will be included in examining James Martin's views on information engineering.

Martin describes information engineering as a pyramid (Figure 2.1). The three sides of the pyramid are data, activities, and technology. The four levels within the pyramid beginning from the top in order of precedence are: *Strategy, Analysis, System Design,* and *Data Construction.* This type of conceptual model builds a knowledge base, which then creates and maintains the information system.

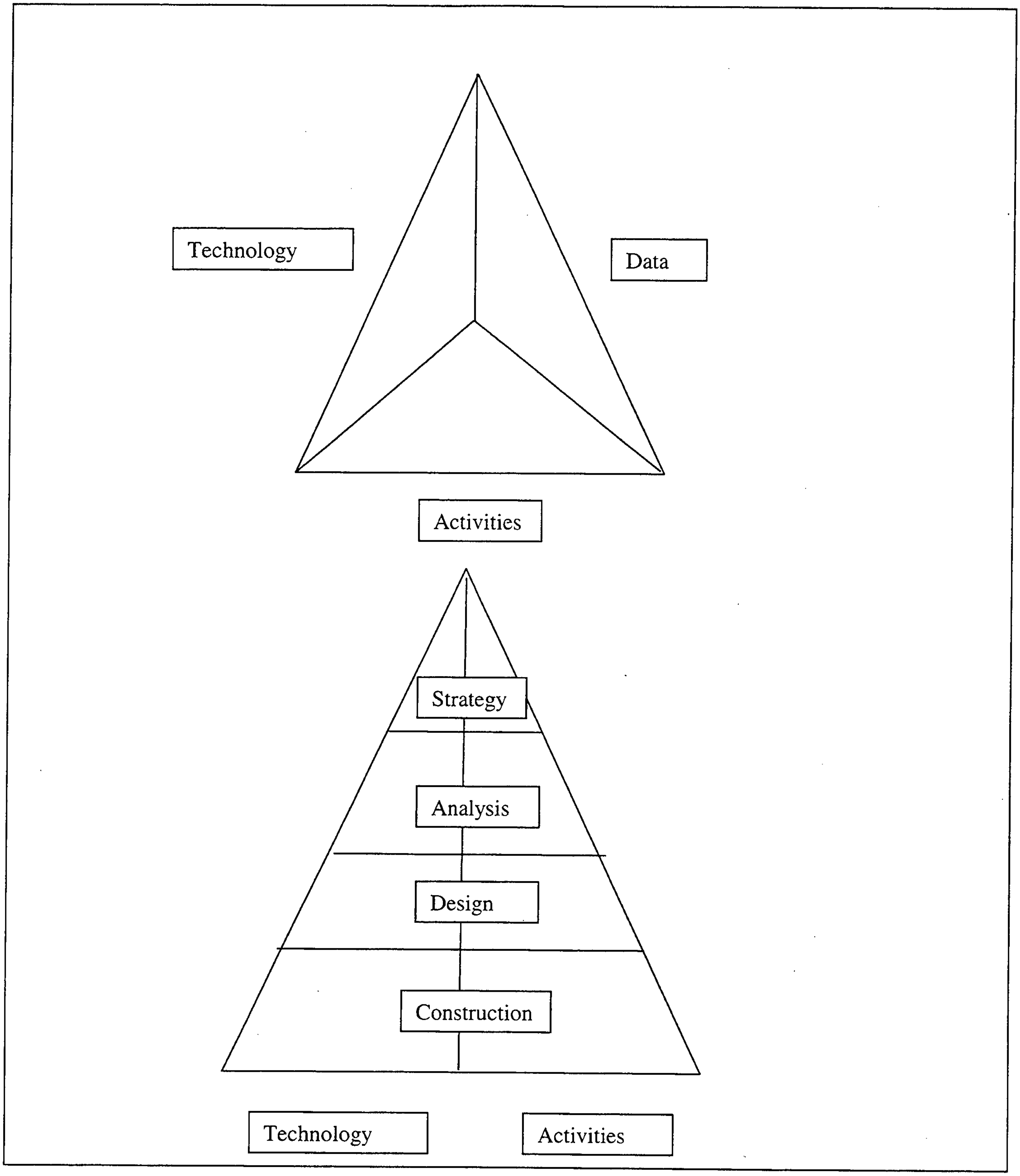

Figure 2.1 Information System Pyramid

1 Information Strategy

Strategy is a continual, incremental process of setting and resetting organizational direction. It should not be elaborate and detailed because we cannot anticipate the future in detail. (Davenport, 1997) Strategy then becomes a dialogue rather than a document. It is a game plan for competing in the business world that is flexible enough to be revised when the situation dictates.

In the broadest sense, information strategy is deciding, in advance, the development of an information system. These decisions must be concerned with the fundamental purpose and direction of the entire organization. The strategy must define the explicit connection between an organization's business plan and its systems plan to provide better support of the organization's goals and objectives and to provide closer management control of critical information systems.

Martin views information strategy as a plan that must be aligned with the business organization goals and objectives. Top-level management must formulate a strategic vision that will incorporate how current and future technology will affect the business, products, and services. The term, "Strategic Systems Vision" has been used to describe the ability to envision which systems can enhance the competitive position of a corporation. (Martin, 1990) This high-level view is based on the business functions data and information needs.

The process begins with interviews of top management and takes anywhere from six to nine months to complete. Top management must decide what information is needed to satisfy their decision-making needs or business process of today, as well as in

the future. This method of determining a strategy often results in identification of problems and solutions both organizationally and operationally. Table 2.3 outlines Martin's objectives of information system planning.

• Investigate how better use of technology can enable an enterprise to gain a competitive advantage. • Establish goals for the enterprise and critical success factors. • Use critical success factor analysis for steering the enterprise to enable it to better achieve its goals. • Determine what information can enable management to perform its work better. • Prioritize the building of information systems in terms of their overall effect on the bottom line. • Create an overview of the enterprise, its processes, and information. • Subdivide the overview model into business areas ready for business area analysis. • Determine which business areas to analyze first. • Enable top management to view its enterprise in terms of goals, functions, information, critical success factors, and organizational structure.

Table 2.3 Objectives of Information System Planning

2. Information Analysis

This level of the pyramid is concerned with the steps needed to be taken to create the information system, but it does not give a detailed explanation of how to accomplish this task. This analysis is similar to Rockart's Critical Success Factors. Studies are done to determine what processes are critical to the success of the business, how they interrelate, and what type of information is needed.

In general, there should be a guiding set of principles concerning design procedures that will serve to direct the process along the line of the overall requirements. A satisfactory procedure must begin with the design criteria or specifications and lead to the development of a useful system.

At this stage, the analysis examines how work is accomplished. This type of information analysis establishes a detailed framework for building an information-based enterprise. It takes one business area at a time and analyzes it in detail. It uses diagrams and matrices to model and record the data and activities in the enterprise. It also uses them to give a clearer understanding of the elaborate and subtle ways in which the information aspects of the enterprise interrelate. The diagrams and matrices are designed to be understood by management, end users, and data processing professionals. As a result, it increases communication among these groups. (Martin, 1990) Figure 2.2 exemplifies the types of diagrams that can be generated by using CASE tools.

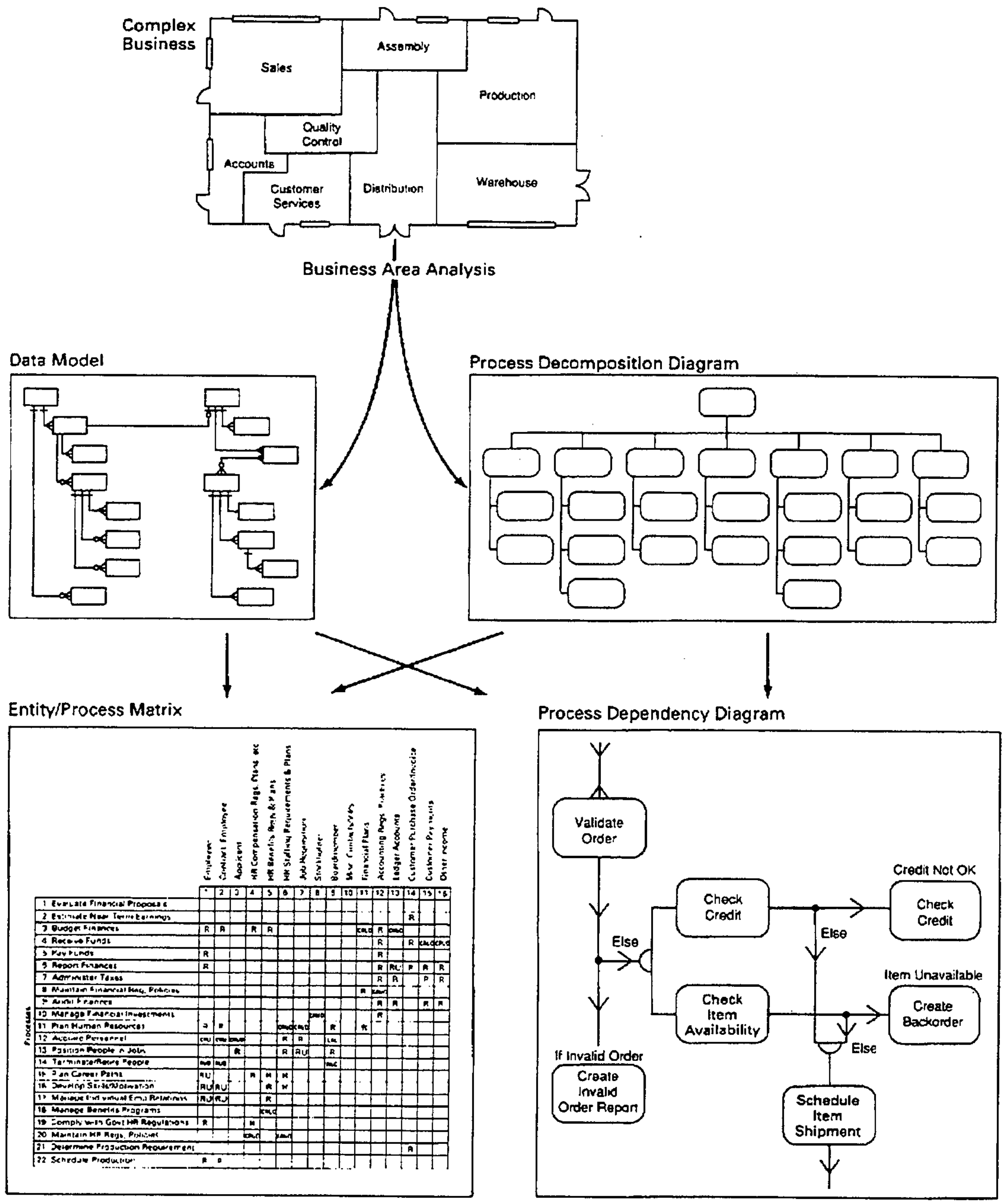

Figure 2.2 Four Main Diagrams of Business Analysis Phase
Source: (Martin, Leben, 1989)

Martin also describes a list of objectives for the information analysis phase (Table 2.4). This outline is a macro view of what design teams will work on separately in the next level of the methodology. Analysts further decompose each activity to produce data flow diagrams that explain the structure of the data independently of how it is produced within the system. The next section will discuss this procedure.

- Provide a clear understanding of the business and how its activities interrelate.
- Provide an architectural framework for the building of systems in an information-based enterprise.
- Provide a framework such that separately built systems will work together. This framework consists of:

  A fully normalized data model which becomes the foundation stone of application design and construction.
  A model of the business activities and their interdependencies.
  A linkage of the foregoing models to show what processes use what data.
- Trigger the rethinking of procedures in the enterprise so that they are as efficient as possible for the era of desktop computers, information networks, and flexible databases.
- Identify requirements of highest priority for information center activities and system design.
- Create an overview so that joint application design sessions can proceed rapidly and coherently.

Table 2.4 Objectives of Information Analysis

3. System Design

This level is concerned with how data will be processed into information. Hardware, software, data architecture, and user interfaces are key issues in the design of the system. CASE tools are then used to model the logical and physical design of the system. The requirements determined from the analysis level are transformed into diagrams that will explain how the components will interact with the user and system (Figure 2.3). Code generation is a by-product of the automated CASE tools used at this level.

In the logical design phase of this level, prototypes of the forms, interfaces, and databases are developed to pattern the interaction between the user and the system. Data flows and relationships among entities (activity data is collected on) are normalized into the simplest, most stable data structure.

In the physical design phase of this level all the technological characteristics, such as databases, programming, computer security, and system controls are specified for the system. Thus, the structure for data storage and management will be defined with the operating system and platform to be used in the database construction level of the pyramid.

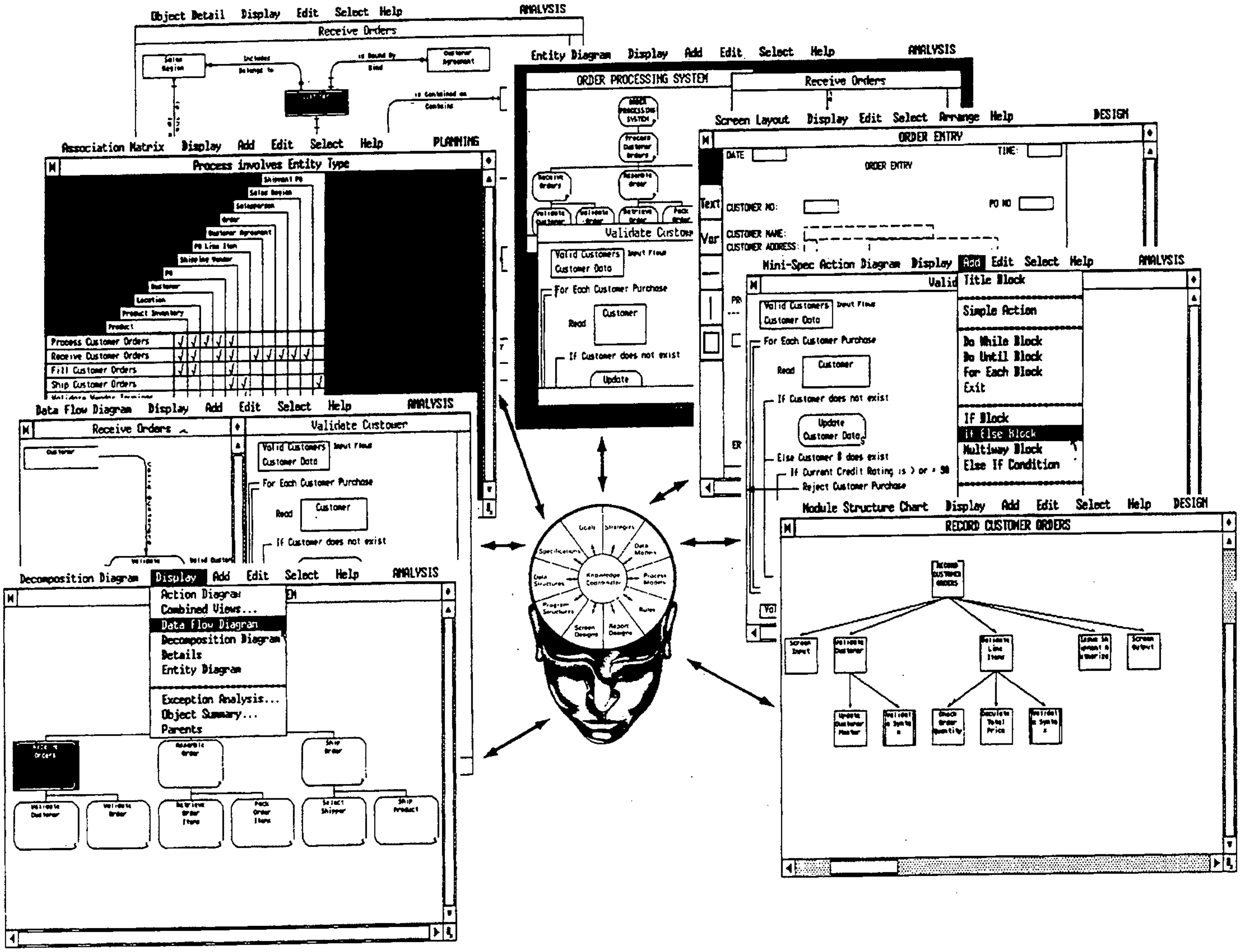

Figure 2.3 System Design Diagrams
Source: (Martin, 1989)

4. Database Construction

The base of the pyramid is where implementation and maintenance of the system are determined. Files, physical database, database management, application programs, and implementation procedures are then produced to form the end system. The code generated from the above levels in the pyramid can be easily imported into database programs, such as Oracle, Informix, Sybase, Access, and a wealth of others. The database can be thought of as the library of the organization where vitals records are kept, which enables users to access information on demand so they can make informed decisions.

C. EXAMPLE OF SISP AT FEDERAL EXPRESS

Federal Express is a prime example of how SISP is used as a means of leveraging advances in technology to gain competitive advantages in the package/shipping business. Federal Express is the world's largest express package transportation company. In 1990, its slogan was, "When it absolutely, positively has to be there the next day."

Fueling Federal Express's growth and success has been the development of a strategic information system that enables Federal Express to provide superior service to its customers. Among the first express transportation companies to realize the benefits of technology, Federal Express has been the leader in the development and use of technology to enhance its services and maintain its leadership. (FedEx Facts, 1999) Customers are able to conduct shipping transactions with Federal Express from their desktops and track their packages via the World Wide Web.

Federal Express flies to 310 airports using a jet transport fleet of nineteen Boeing 747s, one hundred fifty-four Boeing 727s, and twenty-seven McDonnell-Douglas DC-10s. The company also has nineteen McDonnell-Douglas MD-11s. In addition, Federal Express owns 218 turboprop feeder aircraft, which serve smaller communities. More than 30,000 computer and radio-equipped vehicles are in service worldwide. Federal Express also maintains a convenience network of over 1,600 staffed facilities and more than 29,000 drop-off locations. (Federal Express, 1991)

Federal Express's strategic vision is to use technology to improve pinpointing its 1.5 million packages that are processed within seconds each day. (Henderson, 1993) Since 1988, its aging information technology system had been "Held together with Band-Aids and chewing gum," says Jon Ricker, Vice President of Federal Express's Corporate System Development.

A model of Federal Express's system includes processes, such as scheduling pick-ups, deliveries, and aircraft flights, as well as invoicing and billing customers, tracking packages, and providing customers, upon request, with the status of their packages en route. This is, of course, not an all-inclusive list of the processes Federal Express had to consider, but it is representative of a high-level view of the system.

Then, each high-level process had to be decomposed into lower-level data flows that would represent how data in motion moves from one place in the system to another. For instance, data in motion could involve in the process of scheduling a pick-up, validating customer data, processing customer order, and updating customer database. Again, each process would be decomposed into many individual pieces of data that are

generated at the same time and flow to common or different destinations within the system.

To make their strategic vision a reality, Federal Express decided to shift from IBM mainframe computing to object-oriented distributed database computing. Federal Express realized that their critical success factors of command and control of the planning, operation, maintenance, and reporting of their "truck-line haul" --over 400 airplanes and 2,500 tractor/trailers--were better served by this move.

Federal Express analysis of its information needs resulted it the requirement to make local decisions even though it must act globally. Distributed-object technology was the method of choice to allow, both locally and globally, decisions to be made at the same time. The package delivery giant plans were to move mission critical information from central mainframes to regional sorting centers across the United States. The older mainframe systems would remain in place, because they have the capacity to store huge amounts of transactional data and provide a unified view of corporate data. (Bozman, 1995) Now, through the use of distributed object technology, a package sent from any location no longer has to be sorted in Memphis prior to delivery; it can be sorted and sent locally.

The Federal Express Object Project uses approximately 200 Sun Workstations and more than 20 Unix Servers at five regional sorting centers in Memphis. (Bozman, 1995) Sunsoft, Inc. C++ Tool Kit is used as middleware to link end users with data stored on mainframes and Unix servers. End users with window-based PCs or Unix workstations can find whatever data they need concerning packages.

To exemplify the technology Federal Express employs, a few of the their information sub-systems are outlined below.

Super Tracker–When a courier arrives to pick up a shipment, a hand-held scanner--called a SuperTracker–scans the bar-coded label. Bar codes generated by customers using software identifies the shipment destination, the type of service delivery, and the delivery commitment time. (FedEx Facts, 1999)

ASTRA–Automated Sorting Tracking Routing Aid system that again uses bar codes to provide accurate and reliable package delivery information. Each ASTRA label contains all the necessary information to precisely identify each package on its designated route from pick-up to final delivery. (FedEx Facts, 1999)

COSMOS–Customer Operations Service Master On-line system, which is a central component of Federal Express's strategic computer system. It is a sophisticated electronic network that contains critical information on the location of each shipment in the Federal Express system. COSMOS connects the physical handling of packages and related information to the major data systems at Federal Express and, in turn, with customers and employees. (FedEx Facts, 1999)

"Most people say we have the finest tracking system in the world," commented Ron Porter, Federal Express's Chief Information Officer. "But we want to continually add value to the customer – particularly as competitors catch up to our current generation technology." (Wexler, 1991)

The parallelism between Federal Express's information system and that of the Naval Construction Force's information system is one of transportation, distribution, and reporting. Federal Express must transport, distribute, and report the status of customer-generated shipments. The Naval Construction Force must do the same with personnel, equipment, and material associated with its assigned mission. The same procedures are involved in shipping, tacking, and providing information. Command and control of planning, operation, maintenance, and reporting are essential for the Naval Construction Force as they are for Federal Express. The use of bar codes, portable electronic tracking devices, automated reporting systems, and distributed databases would also enhance the Naval Construction Force's ability to meet its information goals.

III. BUSINESS PROCESS IMPROVEMENT

Any discussion of corporate strategic information system planning would be incomplete without a discussion of how to improve business processes, which are the focus of such planning. Business processes are simply a set of activities that transform a set of inputs into a set of outputs. For example, consider waiting in line at the grocery store to pay for your groceries. In this case, the process can be called, "checkout." The process begins when you step into line, and it ends when you receive a receipt for the groceries, allowing you to leave the store with your purchase.

Business process improvement must be thought of in terms of the capabilities information technology can provide. The converse is true when compared to information technology improving the capabilities of business processes. Strategically planning an information system should be accomplished by analyzing how technology will support and improve business processes. (Davenport, Short, 1990)

Gabriel A. Pall, Senior Vice President of Juran Institute, and former Director of the International Business Machine (IBM) Corporation Quality Institute defines business processes as, "The logical organization of people, materials, energy, equipment, and procedures into work activities designed to produce a specified end result." (Pall, 1987) Multiple units of these processes form the business.

Process thinking has become widespread in recent years, due largely to the quality movement. Industrial engineers and others who wish to improve the quality of operations are urged to look at an entire process, rather than a particular task or business function.

Most processes in major corporations have not been subject to rigorous analysis and redesign. Indeed, many of our current processes result from a series of ad-hoc decisions made by functional units with little attention to effectiveness across the entire process. Most business processes were developed before modern computers and communication even existed. (Davenport, Short, 1990)

Improving business processes is paramount for businesses to stay competitive in today's marketplace. Businesses have been forced to improve processes over the past couple of decades because of improvements in technology and increases in customer demands. New technologies are rapidly bringing new capabilities, thereby raising the competitive bar and need to dramatically improve business processes.

A well-known business process improvement can be cited in the computer industry. The business process of manufacturing computer chips for central processing units has increased with improvements in technology and increases in consumer demands. Now, a company wanting to compete in this industry must be capable of producing faster, smaller, and less expensive computer chips for central processing units if the company wants to be successful.

A. CONTINUOUS PROCESS IMPROVEMENT

There exists a dichotomy in business research and literature of how a business should proceed in improving processes within the organization. The first approach is the continuous process improvement model that looks at incremental change in the existing process. Quality management, often referred to as Total Quality Management (TQM) or

continuous process improvement, refers to programs and initiatives that emphasize incremental improvement in work processes and outputs over an open-ended period of time. The concept of continuous process improvement requires that the existing process be stabilized. It then becomes predictable, and its capabilities can be analyzed and improved. The business begins by documenting what they do today. Then, they establish some way to measure the process, do the process, measure the results, and identify improvements based on the collected data (Figure 3.1).

Continuous process improvement can be compared to the process of Plan-Do-Check-Act cycle. This process is also known as the Deming Wheel in honor of Dr. Deming. It is the fundamental approach to continuous process improvement. By definition, continuous process improvement is ongoing and is achieved by continuous rotation of the Deming Wheel.

The situation is analyzed and the improvement is planned (Plan). The improvement is tried (Do). Then the data is gathered to see how the new approach works (Check or study). Then, the improvement is either implemented or a decision is made to try something else (Act). This process of continuous improvement makes it possible to reduce variations and lower defects in business processes.

Document As-is Process ⇒ Establish Measures ⇒ Follow Process ⇒ Measure Performance ⇒ Identify and Implement Improvements

Figure 3.1 Continuous Process Improvement Model

B. EXAMPLE OF CONTINUOUS PROCESS IMPROVEMENT

In the August 8, 1994, edition of *Business Week*, Florida Power and Light Company was the focus of an article entitled: "Selling Bright Ideas—Along With the Kilowatts." Florida Power and Light Company became the first United States' company to capture Japan's W. E. Deming Prize in 1989. The Deming Prize was established in 1951 to honor the contributions of Dr. Deming to the successful quality movement in Japan. Other companies marveled at the utilities 1,800 quality improvement teams.

Florida Power and Light Company kept better records on quality than they did on their basic processes; they had layers of checks and balances for every function in the company. The utility manager's preoccupation with quality issues, billing, and downed lines resulted in a wake-up call to a population explosion in southern Florida and the sudden surge in demand for power. As a result, Florida Power and Light had to borrow electricity from other utility companies.

Many companies would have turned out the lights. But instead, Florida Power and Light revamped its entire quality approach this time with an emphasis on cost reduction. They focused on Deming's dictum: determine reasons for improvement, assess the current situation, analyze, develop solutions, measure results, standardize results, and formulate future plans. (Wiesendanger, 1993) Today, Florida Power and Light's future is much brighter. Its profits increased 23 percent in 1993 to $572.4 million and built its reputation as a Deming winner.

Florida Power and Light has launched a return on quality consulting business. Qualtec Quality Service Inc. has 52 consultants, annual billings of more than $13 million, and a list of 100 clients worldwide. Qualtec's approach is straightforward. First it tries to persuade managers to put aside their old views of quality. The consultants break up management. Top executives through mid-level managers are placed into groups to talk about quality. The message is spread through teams made up of managers and blue-collar workers. Then, with everyone in agreement on how to define quality, Qualtec does a top-to-bottom review the way a company operates and identifies potential quality improvements that could yield financial benefits.

This example demonstrates the importance of the Plan-Do-Check-Act cycle of continuous process improvement. It also demonstrates the importance of identifying the vital processes that need to be analyzed to achieve maximum benefits from such an approach.

C. BUSINESS PROCESS REENGINEERING

The second approach is Business Process Reengineering (BPR), which is the critical analysis and radical redesign of existing business processes to achieve breakthrough improvements in performance measures. (Davenport, Short, 1990)
BPR is a radical method of beginning with a clean slate and reengineering processes. The process is analyzed from the top down across a broad functional base within the organization. This type of procedure is riskier than TQM, because it only looks at the process once.

Michael Hammer states (1990),

> Companies rarely achieve radical performance improvement when they invest in information technology. Most companies use computers to speed up, not break away from, business process and rules that are decades, if not centuries, out of date. But the power of computers can be released by "reengineering" work: abandoning old ways of working and creating entirely new ones. (p. 104)

Hammer goes on to explain that it is time to stop paving the cow paths. We should not embed outdated process in silicon and software. The power of information technology should be used to radically achieve dramatic improvements in business process. A model of this method is illustrated in Figure 3.2.

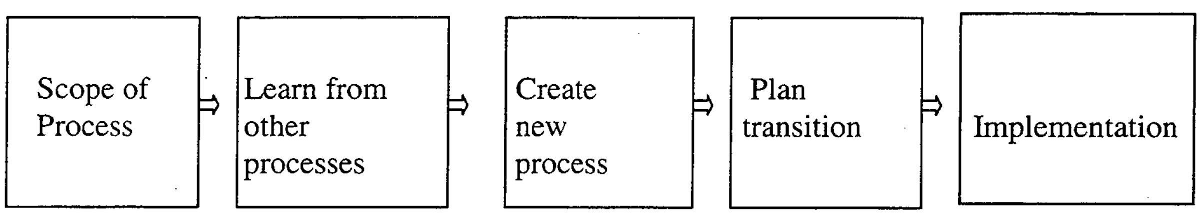

Figure 3.2 Business Reengineering Model

Davenport and Short (1990) prescribe five steps as a business process methodology.

1. Develop the business vision and process objectives – The business vision focuses on objectives, such as: cost reduction; time reduction; output quality; and improved quality of work life, learning, and empowerment.

2. Identify the process to be redesigned – Most firms use the high-impact approach, which focuses on the most important processes or those that conflict with the business vision. Fewer number of firms use the exhaustive approach that attempts to identify all

the processes within an organization and then prioritize them in order of redesign urgency.

3. Understand and measure the existing processes – Avoid repeating old mistakes by providing a baseline for future improvements.

4. Identify information technology levers – Awareness of information technology capabilities that can and should influence process design.

5. Design and build a prototype of the new process – The actual design should not be viewed as the end of the business process redesign process. Rather, it should be viewed as a prototype with successive iterations.

Contrasts between the two approaches are provided in Table 4.1.

	(TQM) Improvement	**(BPR) Innovation**
Level of Change	Incremental	Radical
Starting Point	Existing Process	Clean Slate
Frequency of Change	Continuous	One-time
Time Required	Short	Long
Participation	Bottom-Up	Top-Down
Typical Scope	Narrow, within functions	Broad, cross functional
Risk	Moderate	High
Primary Enabler	Statistical Control	Information Technology
Type of Change	Cultural	Cultural/Structural

Table 4.1 Process Improvement (TQM) Versus Process Innovation (BPR) Source: (Davenport, 1993)

D. EXAMPLE OF BUSINESS PROCESS REENGINEERING

In a case study conducted by the Henley Management College, Rank Xerox was studied for its information technology, driven-process reengineering. Rank Xerox U.K. is a national operating company of Xerox Corporation. In 1987, the company began a comprehensive information technology driven-process reengineering. The company needed to focus on office systems and cross-functional cultures with inefficient business processes that were inhibiting growth.

David O'Brien, the division's managing director, in a series of offsite meetings with senior management, reappraised its external environment and mission. They identified key business processes the company needed to achieve its mission. The group began to restructure the organization around cross-functional processes. A task force was created to define information and other resource requirements for each process. O'Brien decided to keep a somewhat functional formal structure, because functional skills would still be needed in a process organization and the level of organizational change might have been to great with an entirely new structure.

The level of change was still very high. Several senior managers departed because they could not, or would not, adapt to the new environment. Two new cross-functional senior positions, called "facilitating directors" were created. One was designed for organizational and business development, while the other was created for process management, information systems, and quality.

O'Brien states (Denning, Taylor, 1988),

> "Of course, this new thinking was in sharp contrast to some of the skill and attitudes of the company. We were introducing a change in management philosophy in a company that, in many ways, was very skillful and effective, but in a different product-market environment. We feel all the issues of attitude change and retraining that any such change implies. We were moving to a much more integrated view of the world and had to encourage a major shift in many patterns of the existing culture." (p. 10)

As key processes were identified and their objectives determined, the company began to think about how information technology could enable and support the processes. Information engineering and the help of external consultants were used to redefine and confirm processes.

Rank Xerox U.K.'s financial position began to improve as it redesigned its business process. The company emerged from a long period of stagnation into a period of 20 percent growth in revenue. Jobs not directly involved with customer contact were reduced from 1,100 to 800. Order delivery time was reduced from thirty-three days to six days. O'Brien credits process redesign for much of the improvement at Rank Xerox U.K.

The feasibility of adjusting to such radical change encountered through the use of business process reengineering is limited in many large organizations. Cultural and political issues may inhibit such an approach. However, Rank Xerox U.K.'s use of business process reengineering demonstrates how dismal performance can be turned around through this method.

E. BEST MANAGEMENT PRACTICES

Another method of business process improvement that is not at the extreme ends of the spectrum is called, Best Management Practices. Best management practices refer to the processes, practices, and systems identified in public and private organizations that perform exceptionally well and are widely recognized as improving an organization's performance and efficiency. Corporate America recognizes that to survive it has to initiate time-efficient and cost-effective changes within organizations that will make them more productive. Again, federal agencies are facing the same reality. The DOD is a prime example of an agency facing the challenge of streamlining for efficiency and lowering costs while having to maintain quality.

Deciding whether to use a best management practice approach involves considering a number of factors, such as whether departments or organizations have reported the problem area and whether or not there have been attempts to make the process work. They also have to examine whether or not there is a process with similar requirements that can be compared to the one being examined. Finally, they must study whether or not the area being considered has an established counterpart in the private or public sector that will provide evidence of the benefits of a new process. Identifying the scope of the process is not always easy because determining where the process begins and where it ends is difficult.

The first step in beginning a best management practice is to understand the process that is being reviewed. Understanding the process is essential to recognizing

opportunities for improvement. Furthermore, a good in-depth understanding of the process helps to determine an appropriate company to compare the process.

The next step in the best management practice review is to conduct interviews with individuals of the selected comparison company. Preliminary planning and research are key elements of this review. They will provide the interviewer with leading edge companies and techniques already in vogue.

The final step is the best management practice review is to compare and contrast the process to the process of the benchmarked organization. A decision can then be made whether or not the organization can benefit from implementing a newer process.

F. EXAMPLE OF BEST MANAGEMENT PRACTICES

In the business journal, *Planning Review* (Prairie, 1993), International Business Machines (IBM) were chronicled for their work with American Express. American Express is a world-class company that is a leader in its use of information technology. Yet, its top management decided to benchmark its information-technology management processes against other major companies to compare the best of the best. By first determining the best management practices and then implementing them, American Express expected to achieve higher quality, higher morale, lower project risk, and greater productivity.

American Express engaged the IBM Consulting Group to develop a benchmarking methodology aimed at management processes and to identify world-class companies. IBM conducted an extensive benchmark study to identify and describe the best

management practices for information technology strategic processes in large, complex companies. The study focused on how a company's management processes used in information technology to achieve its business goals. American Express was particularly interested in finding the best management practices for developing strategic plans that both aligned information technology with the business and dealt effectively with change.

The IBM team's approach was not to focus simply on quantitative issues but to concentrate their efforts on somewhat more intangible business-related factors. For example, they investigated how well the organization's information technology infrastructure meshed with the company's strategic business process. Then they looked closely at the relationship of the executives with the chief information officer and other key managers.

The benchmarking effort addressed issues that were not only relevant to American Express but were major concerns of all the companies involved in the study. These concerns included information technology responsiveness to business needs, processes that secure strategic alignment with the business strategies; transitioning from legacy systems to ones more suited to today's user needs; and assimilating new technology. In the best companies, senior management, in both business and information technology, displayed significant vision, provided strategic direction, and demonstrated commitment to rigorous planning and execution.

Good business practices, or processes, can always be improved. Organizations do not have to "reinvent the wheel" to ride down the road to success. American Express

demonstrates that observation and emulation are very useful tools in improving business processes.

G. DEPARTMENT OF DEFENSE AND CORPORATE INFORMATION MANAGEMENT

Oddly enough, the Department of Defense (DOD), like corporate America, has already been forced to improve the functional process of information management. The motivation for such change in corporate America was based on financial gains from leveraging information technology, while the DOD's driving force was based on fraud and mismanagement. Numerous scandals captured newspaper headlines with tales of $600 toilet seats and $400 hammers at a time when DOD was spending $9.2 billion a year to acquire, operate, and maintain automated information systems. Consequently, the public was loosing confidence in the military to properly manage their defense systems.

The Reagan Era build-up of the military provided funding for numerous programs despite duplication between services and inefficient design, implementation, and management. As a result, President Reagan created a blue-ribbon commission to provide recommendations on how to address the issues of fraud and mismanagement in the DOD. Headed by Dave Packard of Hewlett-Packard, the Packard commission criticized many of the DOD's management and acquisition processes. The commission urged reforms in both of these critical areas. The major recommendation of the commission was to implement sound management practices in developing information systems.

President Reagan, in his February 1986 address to Congress, requested defense management improvements. Based on this request, the DOD completed a Defense Management Report in July 1989, which set a substantial dollar-savings target for several management improvement initiatives. The Deputy Secretary of Defense established one of these initiatives, called Corporate Information Management, in October 1989. (GAO Report, 1991)

In 1991, the DOD estimated that it could save $2.2 billion over the next five years. The DOD reasoned that it could achieve these substantial savings by developing standards and eliminating multiple systems unique to each service.

Corporate Information Management entails a major effort to improve DOD operations and administrative support by streamlining business processes, upgrading information systems, and improving data administration and other technical areas. The Deputy of Defense laid the foundation for Corporate Information Management by forming an Executive Level Group of high-level industry and Defense Officials. This group was convened to evaluate Defense business practices and suggest an overall direction for the Department. It noted that the DOD has traditionally viewed information management as merely automating existing business processes to cut costs. (GAO, 1991)

The Executive-Level Group observed that when new technology was applied, the benefits often did not materialize. This was principally because little effort was made to first improve processes. The Executive Level Group recommended that the DOD adopt a management philosophy that emphasizes improving business methods before identifying specific computing and communication technologies. (GAO, 1994)

The DOD endorsed the recommendation of the Executive-Level Group. Corporate Information Management then became a top-down effort to simplify and improve functional processes by documenting business goals, methods, and performance measures; identifying and developing improved business processes and data requirements; and evaluating and applying information technology to support these improved business process. Conceptually, Corporate Information Management emphasizes improvement of business methods and incremental gains through the use of techniques, such as best management practices. In addition, management also adopted a strategy to achieve short-term benefits. Under this "migration strategy," the DOD is selecting its best existing or "legacy" systems to effect immediate cost savings and standardization to pave the way for moving to the eventual "target" systems. (GAO, 1994)

IV. CASE ANALYSIS

A. BACKGROUND

The Naval Construction Force has over a half billion dollars of equipment and material at various locations worldwide. The Naval Construction Force maintains and operates shore, inshore, and deep-ocean facilities to support the U.S. Navy and Marine Corps as well as other U.S. government agencies, including the Army and unified commanders. In time of war, the Naval Construction Force must be capable of constructing facilities in support of military operations and defending them. In time of peace, the Naval Construction Force must provide the same proficiency in responding to civil emergencies and disasters, such as floods, earthquakes, and fires. They must also conduct routine scheduled deployments to globally established Seabee Camps. (Seabee Supply Manual) Material readiness and mobility are paramount for the Naval Construction Force to carry out its assigned tasks.

Above any other requirement, the primary mission of the Naval Construction Force (Seabees) is reinforcement and augmentation of combat-service support of the Marine Air-Ground Task Force. The extent and importance of Seabee operations in the Marine Air-Ground Task Force is described in Naval Warfare Publication (NWP) 4-04.1. This publication acknowledges the four functional areas of engineering effort required by a Marine Air-Ground Task Force commander for mission success, which include: *General Engineering, Mobility, Counter-mobility,* and *Survivability.* The effort provided

by Marine engineers across these functional areas is significantly enhanced and complemented when Seabees are employed.

General Engineering. General engineering is the primary combat-service support function performed by engineers to include both horizontal and vertical construction. It is characterized by well-developed design and deliberate construction and includes detailed planning and preparation. In addition, engineers also provide utilities and bulk fuel operations support. The majority of general engineering tasks are performed in the rear area, where reliance on Seabee assets and capabilities is critical. General engineering contributes to force sustainment by enhancing the throughput system within the amphibious objective area.

Mobility. Mobility is the capability of military forces, which permits them to move from one geographical location to another while retaining the ability to fulfill their primary mission. Mobility is enhanced through combinations of counter-obstacle effort (including countermine), gap crossing, forward aviation engineering, constructing and maintaining combat roads and trails, and engineer reconnaissance.

Countermobility. Countermobility is the reinforcement of terrain through the construction of obstacles and emplacement of minefields to disrupt, fix, turn, or block the enemy. The primary purpose of countermobility operations is to slow or divert the enemy, increase time for target acquisition, and enhance weapon effectiveness without impairing the movement of friendly forces.

Survivability. Survivability is the degree a system can avoid or withstand a man-made hostile environment without losing its ability to accomplish its designated mission.

Logistical and tactical planners then determine that a strategy had to be developed to provide the Marine Air-Ground Task Force these areas of engineering support. For any of the strategists' plans to be successful, they had to consider six additional functions with respect to operational logistics and combat-support service. These six additional concerns are: *Supply, Maintenance, Transportation, General Engineering, Health Services*, and *Other Services.*

Supply. Supply is the receipt, storage, issue, and resupply of materiel for conducting operations. After depletion of Seabee-deployed stocks, the supported Marine Air-Ground Task Force will provide mission-critical supplies.

Maintenance. Maintenance consists of those actions necessary to preserve, repair, and ensure continued operation and effectiveness. Sufficient compatibility currently exists with a Marine Air-Ground Task Force to effect intermediate-level maintenance for Seabee weapons, communications, and electronic assets.

Transportation. Transportation is the movement of units, personnel, equipment, and supplies from the point of origin to the final destination. Depending on the distances, Seabee units normally have sufficient organic transportation assets to move equipment and supplies intra-theater. However, Seabee units may request augmenting transportation from the supported Marine Air-Ground Task Force for movement to their project sites.

General Engineering. General engineering is deliberate in nature and oriented towards combat-service support. It provides the construction, damage repair, and maintenance of facilities. Vertical and horizontal construction, damage repair, and maintenance of

facilities are examples of the support generally provided by the Seabees. Combat engineering is not an established capability of the Seabees.

Health Services. The principal goal of health service is maintaining, preserving, and restoring the combat power of the force in both times of peace and war. Medical treatment facilities, organic to Seabee units, are limited to a single aid station in each Naval Mobile Construction Battalion. These aid stations are small and have very limited patient treatment capabilities. While Naval Mobile Construction Battalion aid stations each have an assigned medical officer and as many as seven hospital corpsmen, smaller detachments may depend strictly on corpsmen for organic medical care. Dental capabilities are also extremely limited. Each Naval Mobile Construction Battalion also has one dental officer and two dental technicians.

Other Services. These services provide administrative and personnel support to keep combat forces fully operational.

Prior to 1941, there were no systemized methods of delivering this type of operational support. The Civil Engineer Corps consisted of private contractors who haphazardly accomplished overseas construction. As World War II approached, the need for a combat military organization and a sophisticated construction support, both at home and abroad, necessitated a new and larger military organization of seafaring fighterbuilders. Highly skilled construction workers were recruited into construction battalions, and the Navy Bureau of Yards and Docks was formed to oversee wartime construction projects.

During World War II, when bases were constructed across the island chains in the Pacific Ocean, it became apparent that bases could become more time-efficient and cost-effective if their units of material, equipment, and personnel used to perform the specific functions of the Naval Construction Force were standardized. This was the beginning of the Advance Base Functional Component Systems. (Seabee Supply Manual)

Fleets Commanders-In-Chiefs use the Advance Base Functional Component System as a planning tool to accomplish emergency and normal operational deployments. The Navy has continually upgraded this system since World War II. Like Federal Express's transportation and distribution system, the Naval Construction Force's version is also capable of material identification, packing, and shipping worldwide.

Integral within the Advance Base Functional Component System, each type of Naval Construction Force unit has an allowance of authorized equipment and material. These Tables of Allowances include everything a unit needs to perform its assigned mobilization mission. The Table of Allowances defines the organic mobilization requirements for a generically defined mobile construction battalion. Tables of Allowances are based on a 60-day period of material support. A unit should be able to perform its mission for that time without resupply, except for ammunition, subsistence, rations, and fuel. These Tables of Allowances are also used as the basis for funding and supporting active and reserve units in the Naval Construction Force. (Seabee Manual)

Manually trying to keep track of thousands of line items of data on this equipment and material became labor-intensive. Transaction reports on this data were often late,

inaccurate, and marginally useful. Over time, the Naval Construction Force had to develop an automated management system to maintain these Tables of Allowances.

MicroSnap evolved into the automated computer application program that manages maintenance, supply, and financial data on these tables. MicroSnap is composed of two major sub-systems. One is the Micro Organizational Maintenance Sub-system, which manages organizational-level equipment configuration, equipment maintenance, and associated logistical support data. The other is the Micro Supply and Financial Management Sub-system, which manages material requirement, requisition, receipt, inventory, and financial data.

Data within the Micro Organization Maintenance Sub-system enables overall visibility and evaluation of the key factors associated with maintenance and material management, such as equipment, reliability, maintainability, availability, and condition; part demand data; and maintenance man-hours. (MicroSnap, 1999) The Micro Supply and Financial Management Sub-system reduces labor-intensive supply functions, improves data accuracy, and yields a higher degree of supply department effectiveness. (MicroSnap, 1999)

Policy and procedures for reporting unit status, personnel and combat readiness status, and other related data, particular to the Naval Construction Force Mobile Construction Battalion, are contained in Commander Second/Third Naval Construction Battalion Instruction 3501.A. This instruction outlines the criteria for measuring and reporting Naval Mobile Construction Battalion Status of Resources and Training System

known as SORTS reports. These reports allow commanding officers to provide an overall picture of unit readiness to Fleet-Commanders-In-Charge.

SORTS reports are submitted via naval message traffic. The report contains data on Civil Engineer Support Equipment and Table of Allowances. The report has two parts. Part I contains data labels and data elements, while Part II is the narrative section that allows comments on category ratings that provide a clearer picture of overall readiness.

The data labels and elements in Part I cover general status data, such as change of SORTS processor, task force designator, operational commander, present geographic location, commanding officer, current unit employment, and personnel strength. Part I also provides unit assessment ratings in the categories of personnel, supply, equipment, and training for various reporting criteria. These reporting criteria include command, control and communications, construction, mobility, and fleet support operations.

At a minimum, SORTS reports must be submitted on a monthly basis no later than the 10th of each month. Gathering the data and putting it into the report is a man-hour intense evolution that must be endured each month by the reporting unit. A ten-page worksheet must be completed to determine unit status information. This data is then painstakingly placed in the applicable part of the SORTS message for transmittal up the chain of command.

B. INTENT OF APEX

During October of 1998, the Naval Construction Force implemented Total Asset Accountability through the use of the web-based query system, Apex. It is designed by the Space Warfare System Center in Chesapeake, Virginia. Total asset accountability is the process of sound decision practices based on comprehensive, accurate, and current data. (Thate, 1999) Previously, the Naval Construction Force collected data from various remote sites via different Management Information Systems and manual transaction processes. Hardcopy records of this data were still required to be sent to Brigade Headquarters to update Tables of Allowances manually. The data that resulted from this method of collection was often incomplete, non-uniform, obsolete, and untimely.

Apex has changed the way data is collected and processed to provide total assets visibility, the term for availability of data under total assets accountability. Apex is a framework for the collection of application data, transmission to a data collection facility, verifying data integrity, preparing and loading of data to a web server, and processing of data resident on the web server. (Fuller, 1999) The application-processing site collects the data and inputs it into MicroSnap. The data is extracted, compressed, and transmitted from the processing site to a data collection facility via diskette, Supply and Logistics Transmission System (SALTS), FTP, e-mail, or regular postal delivery. The data is then verified and prepared for loading on an Intranet or Internet web server for query.

Maintenance, supply, and financial data can then be queried by an authorized user claimancy-wide.

In addition, the SORTS report worksheet has been automated by an Excel Spreadsheet. Apex can be queried for data that is inserted into the spreadsheet. Once the spreadsheet is completed it is then e-mailed to Brigade Headquarters for updating the Tables of Allowances.

Hardware required for this system contains Intranet, Internet connectivity components. A local area network is established with Pentium PC servers and workstations. Internet connection is via modems and telephone lines. The web server operates on Windows NT software. The workstations can either be running Windows 95 or Windows NT. An Internet browser is required (Microsoft Internet Explorer, or Netscape). The Apex query software is provided by the Space System Warfare Command and is resident on the web server.

C. SUMMARY

Logically, Apex is a smart move in the right direction on the part of the Naval Construction Force. Using standard query language to extract data and web-based technology to present asset visibility claimancy-wide has its merits. Authorized users can log-on the website (http://www.apex.massolant.navy.mil) and view data with the push of a button. The windows-based graphical user interface is user friendly. Minimal training is required for an operator to use the system.

The major drawback of Apex's implementation is the physical design of the database. MicroSnap is not configured in accordance with the Naval Construction Force's Tables of Allowances. Therefore, querying the database for information to update these tables or reporting readiness based on this configuration still requires work on the user's part.

D. EPILOGUE AND LESSON LEARNED

Developing information sub-systems without a strategic plan leads to islands of information mechanization. The full potential of leveraging information technology can only be accomplished by making a blueprint that will allow the sub-systems to fit together. A comprehensive knowledge-based methodology, like information engineering, focuses on aligning an information system with the pieces needed to achieve the goals and objectives of the organization. If the Naval Construction Force used this type of methodology, they would have uncovered the incompatibility of the physical design of MicroSnap and the Tables of Allowances.

The lesson to be learned from the Naval Construction Force's development of Apex is best described in Latin terms, "Caveat Emptor," otherwise known as, "Let the buyer beware." Organizations must be careful of what they ask for when applying technology to solve their information needs. Apex works as it was designed to do in querying MicroSnap. However, how useful is the information obtained from the queries? Could a better application of this web-based query technology be incorporated into

automated SORTS reporting system, instead of having to manually input data from a spreadsheet into a naval message?

Again, had the Naval Construction Force used a structured methodology, like information engineering, many of these questions would have been resolved at the apex of the pyramid. Subsequently, these questions will remain unanswered until there is a revision or addition of another sub-system.

V. FRAMEWORK FOR NCF INFORMATION STRATEGY

A. NCF INFORMATION STRATEGY

Like the opening analogy of building a battleship being compared to designing an enterprise-level architecture for corporate information systems, the Naval Construction Force must develop a strategic plan to guide them in this endeavor. The strategic plan must center on the Naval Construction Force's ability to render combat-support services to the Marine Air-Ground Task Force while reporting readiness to Fleet-Commander-In-Charge. This top-down information blue print must consider the most efficient means of maximizing the creation and sharing of information to enable effective decision making at all level within the organization.

The Naval Construction Force information strategy should focus on where it is in terms of information technology today, where it wants to be in the future, and what it will take to reach the goal of information superiority over any perceived advisory. Again, as James Martin reasons, the strategy should not be elaborate and detailed but must establish a dialogue of the architectural framework in which sub-systems will fit.

Guidance already exists to create this strategy. Military philosophies, such as Joint Vision 2010, IT-21, and Networking Centric Warfare already provide defense strategies in developing the template for how the Naval Construction Force will leverage technological opportunities to achieve new levels of effectiveness in warfighting. Admiral Archie Clemins states, (Clemins, 1997)

> Today we stand at the brink of a major revolution in how we conduct military affairs, from both an operational and a support standpoint. As the information age in the Navy is poised to enter the third phase of development (new direction and usage of technology), we must go beyond simply improving our tools, and instead leverage those tools to fundamentally change our processes. (p. 51)

Therefore, Admiral Clemins has already begun a dialog of the focus of the Naval Construction Force strategic plan. It is now incumbent upon the Naval Construction Force to continue this dialog within the organization to reaffirm the direction it will take from this point into the 21st Century.

1. Strategic Study

A strategic study of the core business functions compared to the overall information strategy is where the link of information technology and systems planning is established to further facilitate the development of the enterprise-level architecture. For the Naval Construction Force, the first step in this process should be interviews starting with the Commander Naval Construction Force and working down to the level of those responsible for major sub-systems within the organization.

The goal of these interviews is to understand the perspective of the interviewee about the organization, the organization's information needs, and any problems satisfying these needs. Typical questions in these interviews, include: What are the basic goals of your area? What are the greatest problems you have in meeting these goals? What has prevented you from solving them? What value would better information have in these areas? What costs are incurred by inaccurate or untimely information? What is the most

useful information you receive? How would you rate your current information system with respect to types of information, accuracy, adequacy, cost consistency, and ease of use or clarity in presentation?

The answers to these questions should be quantifiable because this information will used to determine the critical success factors of the Naval Construction Force and entered into their organization's encyclopedia. The encyclopedia is a repository of information relating to the planning, analysis, and design of the system. Later, the encyclopedia will be used to interrelate the sub-systems to the enterprise-level architecture.

2. Strategic Vision

Once the answers to the questions in these interviews are analyzed, the critical areas that allow the Naval Construction Force to efficiently achieve its mission can be determined. It is desirable that the Naval Construction Force critical success areas be put into writing. This will form the strategic vision of the organization and ensure everyone clearly understands the goals. This strategic vision statement explains how an organization intends to fulfill its mission over the planning horizon. It clearly provides the basis for policy and decision making on the information system within the organization.

The strategic vision statement will allow lower-level managers to establish their own goals in meeting the critical information needs of the organization. The strategic vision statement can also be used as a tool to investigate how to use technology to gain a

competitive advantage by aligning the strategy of the organization with that of its information needs. In addition, it will allow prioritization of building the information system in terms of what is most important for the Naval Construction Force to perform its work better.

B. NCF SYSTEM ANALYSIS

The key to the information system framework for the Naval Construction Force is to map Strategic Information System Planning (SISP) to the Naval Construction Force current information system. This mapping occurs by analyzing the information needs, as presented in the case analysis in Chapter III, and addressing typical questions asked in the strategic study as previously mentioned. The remaining levels in the information pyramid, design, and data construction, are not a focus of this research and should be relegated to more professionally qualified system design specialists.

To begin the analysis, I asked, " What are the goals of the Naval Construction Force?" Their primary goal is to provide the required combat-support of the Marine Air-Ground Task Force. This goal involves material identification, packing, and shipping equipment and personnel worldwide. These functional areas are interrelated from an information point of view because most of the information required to perform these functions is redundant when observed as a total system. Therefore, proper structuring of an enterprise database will have far reaching benefits for the Naval Construction Force when developing sub-systems. This common source of data will allow more interoperability among sub-systems.

Next, I looked at "What are the other obstacles for the Naval Construction Force to overcome in meeting their goals?" The major obstacle is not having a well-defined SISP to address their information needs and system development. Information Engineering is a comprehensive approach that can be tailored to meet the Naval Construction Force information needs. The significance of using this method is having a method that the Naval Construction Force can use to develop their strategic vision and plan.

The strategic vision will have to incorporate the issues of standards, interoperability, and network-centric computing. This vision will provide a robust infrastructure that will facilitate information dissemination to dispersed Naval Construction Forces. A strategic plan to accompany this vision will have to be flexible enough to embody these issues with current and future improvements in information technology.

I also asked, "What is preventing the Naval Construction Force from solving the problem of not having a SISP?" Top-level commitment is needed to focus on the importance of SISP. As technology is increasing the opportunities and competitive threats, so it becomes increasingly important for Top-level management to work with those in charge of identifying the new opportunities and how addressing technology can be best put to work.

A strategic information system development team should be formed to help assist in identifying these new opportunities for leveraging information technology. The complexity of the Naval Construction Force information needs and the speed at which

improvements in information technology are happening far exceed the ability of one person to effectively manage to any competitive degree.

Then, I considered, "What value would better information have in the Naval Construction Force functional areas?" The value would be more accurate, and timely information that would significantly increase the operational ability of the Naval Construction Force to conduct its mission. Greater value would also be experienced with less administrative time spent collecting, distilling, and reporting of readiness throughout the chain of command. The convoluted fashion in which SORTS data is reported could be streamlined into an automated system accessible via a web-based query system similar to Apex.

Finally, I asked, "What is the most useful information the Naval Construction Force produce?" Information produced by MicroSnap based on data contained in the Table of Allowances is the most useful information the Naval Construction Force produce to control and coordinate their operations. This is where the emphasis should be on making sure the data is accurately arranged in the Tables of Allowances and reflected in MicroSnap.

C. NCF BUSINESS PROCESS IMPROVEMENT

1. Total Quality Management

For any of the principles of SISP to be effective, the Naval Construction Force must rethink its business processes. Quality must be built in to their strategic plan, not

tacked on as an after thought. A good strategic plan is the first phase of improving business process. When the plan is done, every quality process improvement initiative can be traced to an objective in the strategic plan that, in turn, can be trace back to a mission requirement.

It's not feasible and is ill-advised for the Naval Construction Forces to begin with a clean slate and conduct a one-time event, like that of business process reengineering, to improve their business processes. Total Quality Management (TQM), or Continuous Process Improvement, can be undertaken and supported by the Naval Construction Force with minimal impact on its operation and subordinate levels within the command.

The Naval Construction Force's newly formed strategic information development team should first review the structure of the Table of Allowances to ensure that it accurately reflects the allowance of material and equipment in the Advance Base Functional Component System. Then, they should analyze and document all the input processes used to update the Table of Allowances. The same analysis and documentation should be performed by the strategic information system development on how data in the Table of Allowances are reflected and input into MicroSnap. The focus should be on whether these processes are efficient and provide the required information that can be queried later by a web-based system like Apex.

Next, the development team will have to establish metrics on how well the processes are meeting the business goals of the Naval Construction Force. These performance metrics must be based on how the information system is delivering the type of information needed in a timely, accurate, and meaningful fashion. These processes

will have to be performed repeatedly and measured against the established metrics to uncover any improvements that could leverage technology and reduce the inefficient overhead of the system.

2. Alternatives in Improving Business Processes

There is no need to reinvent a better solution if one already exists that will solve the problem. One alternative for the Naval Construction Force in improving its business processes is to benchmark other organizations that have overcome similar problems in developing this type of information system. The U.S. Marines already have a very efficient systems design to provide the same type of information that is needed by the Naval Construction Force in conducting combat-support operations. The Marines use Asset Tracking and Supply System (ATLASS) and Marine Air-Ground Task Force System II (MAGTF II) to meet their operational planning and logistic tracking needs.

ATLASS is a deployable, microcomputer-based supply system that provides the ability to control, distribute, and replenish equipment and supplies in assigned areas operation. It also receives supply support from and provides supply support to other services in the same theater of operations. (ATLASS, 1999)

MAGTF II is also a family of microcomputer-based planning system able to respond to a wide variety of operational requirements. It is designed to provide the operational forces with a toolkit for the rapid planning, sourcing, and tracking of personnel and equipment during all stages of military operations. The mutually supporting, automated systems are designed in accordance with Marine Corps

warfighting concepts to support deliberate and crisis-action planning. These systems improve and condense operational-planning processes through interactive design and database methodologies. (MAGTF II, 1999)

VI. RECOMMENDATIONS AND CONCLUSIONS

A. RECOMMENDATIONS

After examining Strategic Information System Planning (SISP), by focusing on information engineering and reviewing various approaches to business process improvement, I am able to make recommendations and draw conclusions regarding a framework for the Naval Construction Force to use in developing their information systems.

The strategic plan must center on the following four areas: developing a strategy that will maximize the creation and sharing of information to enable effective decision making, increasing the value and manage the risk in information technology investments, infusing business process improvement with technology to increase efficiency, and exploiting emerging technology to achieve breakthrough performance of the developed information system.

I recommend a framework that adopts and tailors a structured SISP methodology, solicits a private business system consulting firm, forms an information system development team, and uses a business process method. Each of these recommendations is further discussed in the following sections.

1. Adopting and Tailoring a SISP Methodology

Information engineering is the best method because of its comprehensive plan for conceptually representing an information system. Information Strategy is the most important level of the information pyramid, as described by James Martin, for the Naval Construction Force to use in developing information system. The strategy must establish the goals and critical success factors that will enable them to achieve their goals. It must create a general overview of processes and information requirements and be understood by all levels within the organization. The strategy must then determine how to use emerging technology to gain a competitive advantage in information superiority and prioritize the building of the information system in terms of the overall effect on investment in such technology.

Once a strategic plan is formulated, the Naval Construction Force can tailor the remaining levels of the information pyramid to correspond to their organizational environment. The Naval Construction Force is not comprised of system analysts that will be capable of the decomposing, flow diagramming, and designing databases. However, those who are tasked with the job of managing these types of developments will have a standard by which to compare ongoing and future information system projects.

2. Soliciting a Private Business System Consulting Firm

Understanding that the Naval Construction Force is not a computer-intense organization, the subordinate levels of the pyramid could be addressed by a private consulting firm experienced in the development of information systems. The knowledge gained by adopting information engineering as a structured methodology will again be a

tool for the Naval Construction Force to use in articulating their information requirements. It will enable them to ask developers the appropriate questions when discussing plans for constructing an information system.

3. Form an information system development team

The task of developing an information system should not involve just one person. A diverse team from the different groups interested in the system will increase the likelihood of success and acceptance of the changes a new system or modifications will cause. New and different ideas for the system will be the result of team members from different backgrounds and skill levels within the organization. Top-level commitment to this team effort is essential in validating the importance of the information system to the organization.

4. Use a Business Process Improvement Method

The Naval Construction Force needs to ask three very important questions when it comes to improving their business processes. How does what we do compare to what others do who have the same responsibilities? Is this the best way to do it? How often should we monitor what we do to see if it's still efficient?

The first question can be answered by using benchmarking techniques. There is no need to reinvent a better solution if a model from other organizations with similar missions exists that will solve the problem. The second question can be answered by using the techniques of best management practices. Choose the best solution that already exists through comparison of its use and other solutions by leading organizations. The third question çan be answered by using Total Quality Management (TQM). It would not

be prudent for the Naval Construction Force to begin with a clean slate and conduct a one-time event, like that of business process reengineering, to improve their business processes. The cost and development effort would not yield a substantial continuous return on investment. TQM can be undertaken and supported by an organization with minimal impact on its customers and subordinate levels within the command resulting in long-range competitive leveraging of information technology.

B. CONCLUSIONS

The findings of this research resulted in the conclusion that the military can benefit from SISP used by corporate business to integrate their information systems. Since the mid-1980s, corporate business has been on the leading edge of harnessing information technology to gain competitive advantages in the marketplace. Corporate business realized early that information is a resource, which needs to be managed for increased productivity. They also realized that automation is only a tool to provide managers access to the information they need to make decisions. The military has been lethargic in recognizing this fact. However within the last decade, the military is now recognizing information as the weapon of the 21st century.

The military can only manage information successfully by following a strategic plan that integrates the elements of information engineering, coupled with a quality plan for process improvement. Alignment between strategy and process is essential to an efficiently operating military. Every business process initiative in the Department of

Defense (DOD) should be traceable to an object in the strategic plan, which can be traced back to a mission requirement.

A combination of management science and information technology can lead to more effective usage of data resources within the DOD and the Naval Construction Force. Information technology management is business management with an information technological view of how things should be done. Improving functional processes, prior to developing an information system, is a key element in the success of the Naval Construction Force's future information technological investments.

In the Information Age, knowledge is power; information is the means to obtain knowledge. This information will provide a competitive advantage to those organizations that have mastered streamlining their business processes with the goals of their strategic plan.

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